TP 5079E

german & milne inc.

Prepared for the
Transportation Development Centre
Transport Canada

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Montreal, Quebec
Ottawa, Ontario

TP 5079E

INSPECTION AND EVALUATION OF THE CANADIAN COAST GUARD AIR CUSHION ICEBREAKING BOW

for the
Transportation Development Centre
File D1460-163-14-8

Report No. 7076-R.07

January 1984

The contents of this report reflect the view of the Contractor, and not necessarily the official views or policies of the Transportation Development Centre, Transport Canada.

PROJECT TEAM

The project team for German & Milne Inc. was composed of:

- Craig Carter, Project Co-Ordinator
- Lawrence Sundell, Technical Supervisor
- Terry Sundell, Project Technician

and others.

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German & Milne Inc. gratefully acknowledges the co-operation, response and advice of:

- Messrs. J. Leddy of Vulcan Machinery and Equipment Limited, and M. T. Skinner of Rematech Industries for their co-operation in supplying pricing information for the modifications and repairs.

- Messrs. N. E. Rudback of TDC, and M. A. Ball, R. G. Wade and B. W. Robertson of CCG.

- Capt. G. Stieh, CCG Sub-Base, Thunder Bay.

- Mr. D. Gariépy of Supply and Services Canada, the Science Procurement Manager.

and,

- Mr. J. Laframboise of TDC, the Scientific Authority.

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17. Abstract

Between May and October 1983, the air cushion icebreaking bow (ACIB) operated at Thunder Bay by the Canadian Coast Guard (CCG), was stripped down and inspected in order to produce a list of repairs and modifications to be carried out prior to the 1983/84 operating season.

This list was submitted to CCG for approval, and is included as an appendix to the report. Items covered fire suppression system, skirt and notch boom structure repairs, as well as re-arrangement of hydraulic and electrical circuitries.

Maintenance work was carried out during tenure of the contract, as well as some preparatory work for the 1983/84 operating season, as time allowed.

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	J.E. Laframboise

17. Résumé

Entre mai et octobre 1983, la plate-forme brise-glace à coussin d'air (ACIB), utilisée à Thunder Bay par la Garde côtière canadienne (CCG), a été démontée et inspectée afin de dresser une liste des réparations et modifications à faire en vue des opérations de l'hiver 1983/84.

Cette liste, soumise à la CCG pour approbation, est incluse en annexe dans ce rapport. Elle couvre: le système anti-incendie, les réparations aux jupes et à la structure des segments d'accouplement, ainsi que la révision des circuits hydrauliques et électriques.

Durant cette période, et en fonction du temps libre, on a procédé à l'entretien courant du véhicule ainsi qu'à quelques travaux préparatoires pour la saison prochaine.

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1.0 INTRODUCTION

Following the discovery of air cushion icebreaking in the winter of 1971/72, and subsequent successful trials using the modified Arctic Transporter ACT-100, a purpose built air cushion icebreaking bow (ACIB) was ordered by Canadian Coast Guard (CCG) in 1979 from Hovercraft Systems Limited (HSL), of Calgary. Following the inability of HSL to deliver this ACIB as specified, two years elapsed before the craft was delivered to Thunder Bay for trials. After assembly and checkout, some inconclusive tests were conducted at the end of the 1981/82 season, during which a number of deficiencies became evident. Most of the problems were solved, at least temporarily, prior to the 1982/83 season, when a successful series of trials was carried out with the tug THUNDER CAPE and the CCGS ALEXANDER HENRY (see TP 4446E).

Between May and October of 1983, the ACIB was stripped of equipment, structure and skirts to assist in carrying out repairs, inspection and approved modifications. The only items of equipment remaining on board were the engines, fans, control platform, hydraulics and winches, all fully operational and serviced as of 1st November 1983.

Work at Thunder Bay went very well due primarily to the exceptionally good weather. Almost all on-site work was completed on schedule. During dismantling of the notch segments, extensive damage to the booms was discovered, this damage being due to ice forming inside the tubing.

All skirt and notch segments were stacked on-site ready for repairs. The notch booms were also stacked, ready for repair and painting. In general, the ACIB was prepared for the work required prior to any new program.

The operations and maintenance manuals were completed in preliminary draft form, along with a tentative modification list, both of

which were submitted to the appropriate authorities for review and decision.

The work at Thunder Bay was stopped on 18th September 1983, all rental equipment being returned and the technician laid off. Preventive maintenance was continued until the end of October. As of that date, the ACIB site was closed down and the Technical Supervisor laid off.

2.0 WORK COMPLETED

The following is a list of work items which were completed during the contract period:

- o 500 hour inspection.
- o Skirt and segment removal.
- o Notch segment removal.
- o Engine cover extension and fan deflector removal.
- o Hydraulic and winch repairs.
- o Clutch and U-joint inspections.
- o Removal of overhead wiring trays and wiring.
- o First draft of modification list.
- o First draft of operations and maintenance manuals.
- o Running maintenance and system checkout.
- o Installation of safety covers over drive train.
- o All excess wiring removed.
- o 50% of deck seams welded.

3.0 WORK DEFERRED

The damage to the notch booms was found to be quite extensive, needing special equipment for repair and testing (see Appendix "A"), and beyond the capacity of the on-site personnel. Some studs in the notch booms were found to be too short and will be replaced. However, the work was not of an urgent nature and was deferred in favour of items more suitable to the personnel available.

4.0 ACIB SERVICING AND MAINTENANCE

During the reporting period, the Technical Supervisor performed weekly servicing and maintenance checks of the ACIB. This included an engine run up and checkout of the electrical control and hydraulic systems. All systems were left in a fully serviceable condition as of 1st November 1983.

NOTE: The hydraulic interconnect lines that were in the overhead wiring trays were re-connected so that the hydraulics could be run periodically to check system serviceability.

5.0 SHORTENING OVERHEAD WIRING

In order to make efficient use of the Technical Supervisor's time while carrying out the running maintenance of the craft after the initial shutdown of the 18th September, it was decided that he should identify and shorten the wiring which had been in the overhead wiring trays. This was done at no extra cost and did not compromise his safety while working alone on the craft.

6.0 MODIFICATION LIST

Mr. P. Markham has discussed the preliminary list of modifications with the appropriate authorities in the Canadian Coast Guard and the Transportation Development Centre. (See Mr. Markham's letter dated 27th September 1983 to Mr. R. G. Wade, Superintendent ACV Engineering, CGSV/M and Mr. R. G. Wade's letter dated 28th September 1983, to Mr. P. Markham, G&M Inc.)

Appendix "C" lists the modifications considered. Some of these were not investigated in detail because it became apparent that time was being spent on items which might not be implemented. In fact, no approval for any work had been received at the time the contract ended.

7.0 MANUALS

The operations and maintenance manuals have been completed in preliminary draft form. During the 1983/84 season, they will be revised and updated as the new modifications are implemented and appropriate new procedures introduced. They will also be checked for completeness and clarity during operations.

8.0 CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations may be drawn from the program:

The ACIB is structurally sound, but the structure needs painting to prevent further deterioration by corrosion.

Past experience with hot bonding of the skirts and the durability of the ACT-100's hot bonded skirts and soles, suggests that hot bonding will greatly increase the serviceability of the ACIB skirts. The 1982/83 season demonstrated that properly manufactured skirts are capable of surviving an entire season.

The ACIB needs a properly equipped site from which it can be operated and maintained. The site need only be equipped to handle minor repairs, items which two people could handle, but should have access for the heavy equipment required for more specialized work.

The implementation of the suggested modifications will greatly improve the safety, reliability and the maintainability of the ACIB, and its operation, particularly as an unmanned craft.

APPENDIX "A"

REPORT ON NOTCH BOOM DAMAGE

REPORT ON NOTCH
BOOM DAMAGE

DSS Contract No. 10SD.T8200-3-3525

Prepared by

C.W. Carter

Approved: D.A. Kastner
Technical Manager

Copies to: Scientific Authority - 3
Contract Authority - 1
CCG Design Authority - 1

Work Order No: 7076

Report No: 7076-R02

August 8, 1983

INTRODUCTION

On July 20, 1983, a problem was discovered concerning the notch booms. The problem appeared to be only two cracks in one notch boom structural member. It was thought that the damage could be repaired in situ by the two technicians on site.

After the technicians had completed the removal of the notch segments and carried out a detailed inspection of the notch booms, it became apparent that the problem was much larger and that repairs were going to need specialized equipment and that repairs could not be done with the booms in place.

DAMAGE

The damage to the notch booms is as follows:

1. Number 1 notch boom (example in figure 2)
   a) Member 4 split along the seam (crack 1)
   b) Member 11 split along the seam in the third bay outboard (crack 2)
   c) Member 13 split along the seam underside (crack 3)
2. Number 5 notch boom (example in figure 5)
   a) Member 3 split along the seam in bay #1 outboard (crack 1)
   b) Member 11 split along an edge in bay #4 outboard (crack 2)
3. Number 6 notch boom (example in figure 4)
   a) Member 4 split along the seam (crack 1)
   b) Member 9 split along the seam (crack 2)
   c) Member 13 split along the seam (crack 3)
   d) Member 11 split along the seam in bay #4 (crack 4)

.../2

4. Number 8 notch boom (example in figure 3)
   a) Member 12 split along the seam (crack 1)
   b) Member 13 split along the seam (crack 2)

CAUSE

When inspected, most of the tubes which were cracked were found to contain varying amounts of water. This leads to the conclusion that the tubes had not been properly sealed and became filled with water which, upon freezing, caused splits in the tubing.

REPAIR PROCEDURE

The recommended procedure for repairing these booms is as follows:

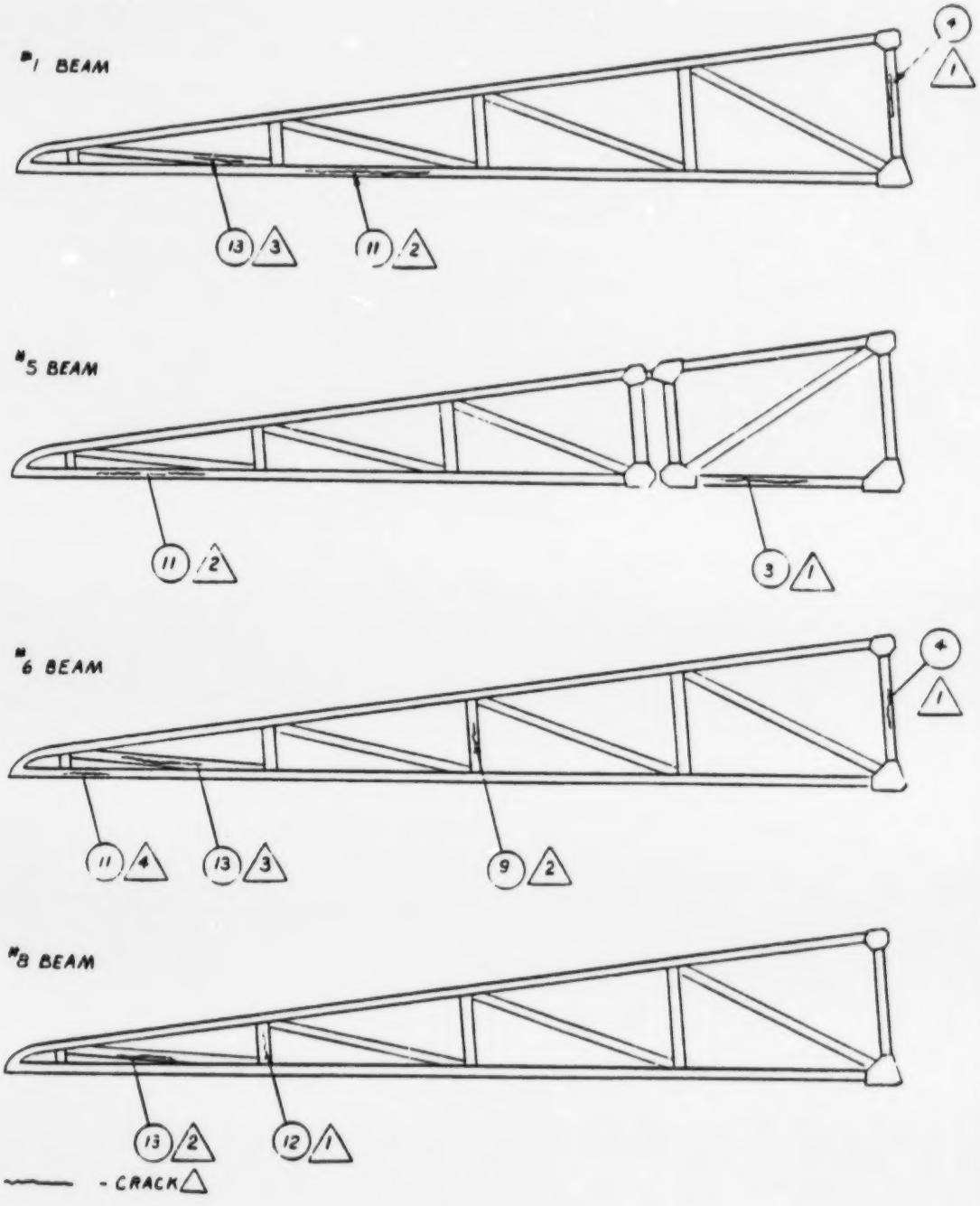
1. Grind out all cracks and reweld.
2. Drill, tap and install a suitable fitting in each tube, then pressurize.
3. Check for leaks with a soap solution. Weld shut all leaks thus discovered.
4. Inject an oil solution into the tubes to reduce the possibility of internal corrosion.
5. Remove the pressurizing fitting and plug the holes, leaving some oil inside each tube.

COST OF REPAIR

Vulcan Machinery was asked to inspect and price the above repair. Their price included the following:

1. Pick up 8 units, take to their shop and re-deliver.
2. Weld all 4 units with 11 visible cracks then test entire unit for leaks by procedure outlined above.
3. Plug leaks discovered during pressure tests.
4. Inject oil solution, remove pressurizing fitting and plug hole.

Total price $2900.00 (Vulcan)



A.C.I B — NOTCH SECTION

FIGURE 1

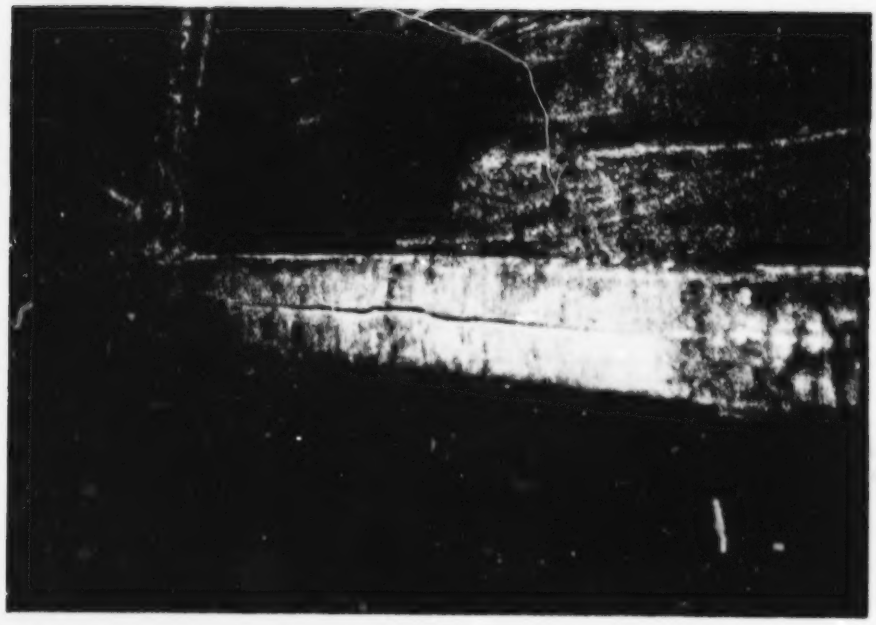


Figure 2: Crack near outer end of number 1 boom

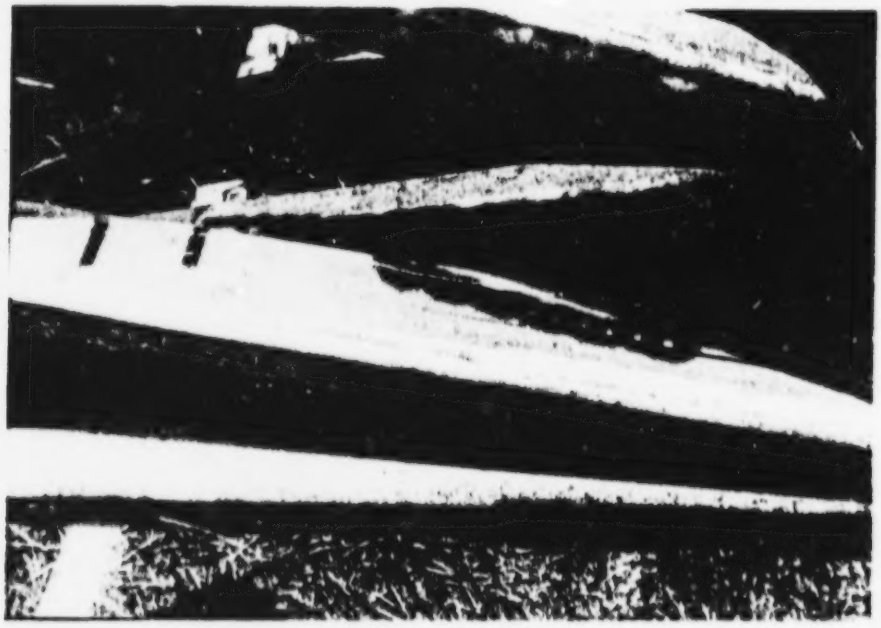


Figure 3: Crack on the outer most diagonal of boom number 8

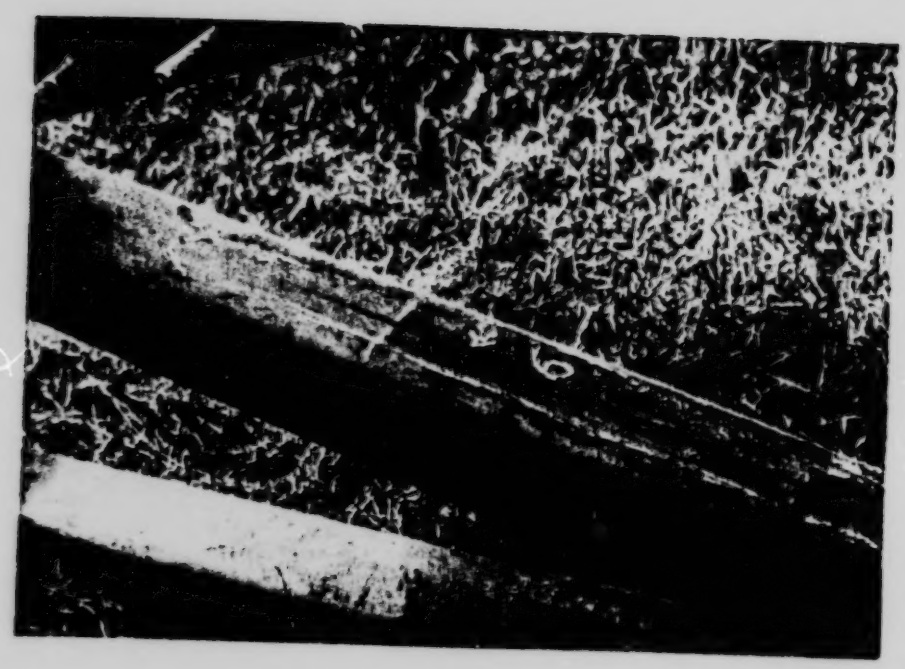


Figure 4: Crack in outer most diagonal of boom number 6.

Figure 5: Crack on the corner of the bottom tube at the outer most section.

ACTION REQUIRED

The notch booms are an essential part of the ACIB structure. They have been considerably weakened by these cracks. It is necessary to test and plug all eight booms to prevent any further failures.

Approval is required to proceed with the repair as outlined above and for money to be set aside to cover all costs of the repair.

APPENDIX "B"

MR. P. MARKHAM AND MR. R. G. WADE'S LETTERS
ON
PRELIMINARY LIST OF MODIFICATIONS

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130 Slater Street, Suite 630
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Telephone: (613) 230-6201 Telex: 053-4499 GERMIL OTT

Your Ref: M.9814-4-1

Our Ref: 7076

27 September, 1983

Canadian Coast Guard
Transport Canada
Place de Ville, Tower A
Ottawa, Ontario
K1A 0N7

Attention: Mr. R.G. Wade, Superintendent ACV Engineering, CGSV/M

ACIB Certification

Dear ~~Sir~~ Ron,

Reference our telephone conversation of 22 September 1983, this letter is to outline the situation with regard to action required for ACIB certification. The comments made in your letter, dated 29 March 1983, are reviewed.

1. Adequate Fire Safety for Engines

Tests on this system in 1982 showed it to be unacceptable.

Enquiries have indicated that the Halon capacity is more than adequate; in fact, specialist advice suggests that there is enough for a two-shot system. It has been concluded that the problem is not with the fire extinguishing system itself, although the nozzle positions are not ideal, but with the cooling air flow through the engine enclosures.

It is known that the flow is inadequate, because at temperatures near freezing it in necessary to open the enclosure doors to obtain adequate cooling. This is due to the cooling air louvres having insufficient area. There is also a problem with the air intake because the position of the louvres is governed by coolant temperature and, consequently, they do not close automatically on emergency shut down. Undesirable leakage of Halon is inevitable.

.../2

It is proposed to increase the louvre area to provide adequate air flow under all operating conditions, and to modify the air inlet controls to provide quick and positive closure on emergency shut down. Sealing of doors and panels will also be carried out as necessary, and extinguisher nozzles will be redirected and shielded.

If the system can be converted simply to two-shot, this will be considered.

A proof test will be required after modification.

2. Hydraulic System

The hydraulic system has been considerably modified to overcome a number of problems, and its primary deficiency now is that it is messy, However, it does work. The work done is summarized in TP4446E, Trials Report - 1982/1983, para 2.2.4.8. The narrative part of this paragraph clearly indicates application under pressure of time of the 'quick fix', which explains the present situation.

Ideally the system should be completely redesigned and replaced,but this would be extremely expensive.

As a compromise, we have suggested the following modifications, which still require an expenditure of about $30,000.00:

- Provide for operation of all four winches simultaneously
- Move winches to provide better all round clearance
- Replace hoses in hydraulic power packages with steel lines
- Replace long lines overhead with steel lines on deck
- Replace existing reservoirs with single reservoir

The possibility of installing clutches in the pump drives has been investigated for us by Vulcan Machinery and Equipment Limited, who advise that there is not space for them in the present installation.

No specification for the existing piping is available, which may well dictate replacement as recommended above.

It is suggested that a careful review of the hydraulic system by CCG is required.

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3. Winches

The winches have been entirely satisfactory. The brakes are very adequate and the load limiters also operate well. 'Dead man' controls were fitted last season. We have recommended fitting 1 inch cable to the transit winches so that the load limit may be increased to facilitate handling in ice.

4. Controls and Indicators

Gauges have not yet been marked with operating ranges. This would be done as part of a recommendation concerning the redesign of control panels.

5. Emergency Bridle (Pitch down in event of loss of cushion Pressure)

If cushion pressure should be lost, the ship will be pushing the ACIB from the blocks at the bottom of the carousel, a point well below the centre of gravity. The effect of the attachment cable will be small.

Should the ACIB be in ice when cushion pressure is lost, it is reasonable to assume that it will run up onto the ice, the geometry of the under deck structure virtually guaranteeing this.

However, over water the skirt drag will undoubtedly be a factor and might result in nose down pitch. The only way to be certain is by testing, either model or full scale. It is suggested that full scale tests could be carried out at the end of the 1983/1984 season. These would be simple and safe, and would require measurement of pitch angle change as speed is increased by small increments.

In any case, the feasibility of an emergency bridle as a safety measure is doubtful because of the enormous loads and unfavourable angles involved.

Tests have shown that cushion pressure can be maintained on one engine, which, itself, indicates a very high safety factor. However, if it is still considered that the possibility of pitch down should be checked, and it would be good to know, tests should be scheduled for the coming season.

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6. On-Board Life Saving and Emergency Equipment

It is recommended that a new scale of life saving and safety equipment should be prepared by Ship Safety/CCG, and that the location of this equipment should then be determined and approved. Both should be posted on board. Manned operation should be assumed, since this will cover both manned and unmanned cases.

The original specification is all that seems to be available for guidance.

7. Ship/ACIB Access

Access between the ship and the ACIB is by a ladder, which can accommodate changes in hover height by rolling in tracks on the deck of the ACIB. The positioning of this ladder is not ideal, it is offset from the centre-line, but this is dictated by the deck area assigned to concrete ballast blocks.

The ladder is quite acceptable for general access, but is not considered adequate for emergency evacuation. Scrambling nets over both sides of the bow appears to be the only realistic measure.

8. Proposed Liquid Ballast and Trim Systems

At present, the ACIB is ballasted by placing concrete blocks (approximately 4000 kg each) on deck, up to a total of twenty two. Ballast can only be varied by use of a crane at the dockside, which is costly; it cannot be jettisonned in emergency, which is undesirable; it occupies deck space, which is uneconomical; and it raises the centre of gravity, which affects stability.

The craft is trimmed fore and aft, primarily to compensate for variable cushion area in the notch, by means of two trim tanks, each holding 4,500 litres of water, in heated enclosures. If water has to be retained for trim, the heaters must be kept on at all times to prevent freezing.

It is proposed to install a liquid ballast and trim system, using diesel fuel, to replace the present, unsatisfactory arrangement. Basically, the existing flotation tanks, which have double bottoms, would be modified to hold fuel for ballast, and two new underdeck tanks, located as far aft as possible, would hold fuel for trim. These tanks would contain appropriate baffles, pumps, valves and vents, would be protected to comply with appropriate regulations, and would form part of the fuel system. In emergency, fuel could be jettisonned to lighten the vessel.

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Apart from greatly simplifying the ballasting and trimming operations, and the much improved safety, removal of ballast from the deck of the ACIB would aid movement on deck, and would permit deck cargo to be carried should there be interest in extending the use of the ACIB to other tasks in other seasons.

9. As-Built Drawings

The existing drawings have been reviewed, and those requiring amendment or redrafting have been noted.

Some drawings have been revised under a TDC maintenance contract, but further work has been stopped until the repair and modification program for the 1983/1984 season has been approved and the configuration reasonably fixed.

10. Operating and Maintenance Manuals

These items are being prepared under a TDC maintenance contract, and will be available before the 1983/1984 season.

11. Engine Clutches

In spite of the failure of the centrifugal clutch on the port engine in February 1983, it is not considered that the situation is serious, and that further action, for example to replace the clutches, should not be considered at this time.

BLM operating instructions state that clutch engagement takes place between 800 rpm (fully disengaged) and 1,400 rpm (fully engaged); in between there will be some slip, depending, of course, on load. Warm up is recommended at not less than 800 rpm, which can obviously involve some friction in the clutch.

The ACIB installation has good heaters, which have given good starts,and warm up is now being carried out at a little below 800 rpm. The minimum engine speed for hover has been set at 1,400 rpm, so that the running time between 800 and 1,400 rpm is minimized.

In addition, until it is clear that this procedure is satisfactory, the clutches are being inspected daily, which is a simple task.

.../6

Your acceptance in principle of these items is requested, together with your comments on any specific items.

Notification of the omission of any item required for certification would be appreciated, so that it can be investigated quickly.

Yours truly,

GERMAN & MILNE INC.

Phil

Philip Markham

Copies to: Mr.M A Ball, Aviation/ACV Engineering, CCG, CGVP

Mr.J Laframboise, Senior Development Officer, Transportation Development Centre, DPM

Canadian Coast Guard / Garde côtière canadienne
Air Cushion Vehicle Division,
Ship Safety Branch

Ottawa
Ontario K1A ON7

RECEIVED
SEP 30 1983

28 September 1983

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M.9814-4-1

Mr. P. Markham,
German & Milne, Inc.,
130 Slater Street Suite 630,
Ottawa,
Ontario K1P 6E2

Dear Mr. Marham,

Thankyou very much for your letter dated 27th.September,which has been carefully considered together with comments made in the ACIB Trials Report 1982/83, TP 4446E. The following commentary is made in the light of the almost total ignorance of this Division as to the owner's future intentions for the operation and certification of the ACIB, and their reaction to proposals made,It is noted that you address this point by asking that the contents of your letter be "accepted in principle" - they certainly are, with possibly one exception, qualified as always by the proviso that certification of each item can only be considered when full details of the proposals are submitted,and that they will be considered both individually and collectively.

Taking your items in sequence :-

1. Engine fire safety.

Your discussion is very clear and valid, and any resulting proposals will be considered and discussed. It should be made clear that,although you only discuss the engine fire protection, Item 14 below and some of the other proposals if implemented may warrant more extensive consideration of fire safety provisions.

2. Hydraulic System.

Agree entirely with your comments - with the one exception mentioned above. If the system is to be modified to a single reservoir, special consideration would need to be given to safety implications resulting from a single failure. While it is appreciated that the original twin tank system was modified effectively to a single-tank system with the balance pipe, I believe that the pipe had provision to isolate a leak or failure.

With regard to specifications, these are probably available from the original HSL purchase orders in Mr. Ball's custody or from my inspection reports in the same place.

Again, the operator must make clear his operational requirement, to determine the amount of re-design required for certification.

3. Winches - fully agree.

4. Controls and indicators fully agree - see Item 12 below.

5. Emergency Bridle.

I have discussed this at length previously in very similar terms to your own, and believe that it may prove more of a hazard than a safety feature. Tests such as you describe were in my original certification trials

requirements, and would certainly be a feature of any future certification. I am not convinced that model testing would be sufficiently representative of full scale.

6. L.S.A.

Agree; a scale will be developed in conjunction with the operators once their intentions have been defined. See Item 14 below.

7. Ship/ACIB access.

The ladder was never, if I recall correctly, intended for other than occasional access to and from the ACIB for "watchkeeper's rounds". In the event of a failure requiring a crew on board for some time, it would be the ship's Captain's responsibility to make any necessary additional access available, but since the ACIB would be off-cushion, the possibility of an emergency was remote. Again, if operator's intentions have changed, this would need to be re-assessed - see Item 14.

8. Ballast.

Agree in principle. Detailed proposals required, and these may require consideration of revised structural assessment. In this context, it is noted in passing that the ACIB has been operating at weights in excess of those for which the original structural assessment was made.

9. As-built drawings.

Agreed. All original HSL and Bell Aerospace drawings held by this Division have now been transferred to your office to assist in the preparation of new drawings.

10. Manuals.

Drafts should be submitted for acceptance - but there seems to be little point in this until the final design has been frozen.

11. Engine Clutches.

The original choice of clutch was queried and is far from ideal: this is borne out by one failure and several signs of overheating in relatively very few operating hours. However, the situation can be accepted if adequate operating and maintenance procedures are defined and complied with.

12. Control panel changes.

This was discussed in conversation and is referred to in your Item 4, but not directly addressed. Revision of the on-board controls is safety-related,and proposals would be considered.

13. Electrical system.

This was not discussed nor was it referred to in your letter; I apologise for not raising it, but equally I am surprised that it was not in your letter. From the comments in the Trials Report, the electrical system is in more of a mess than the hydraulics. It most certainly is a safety consideration, and proposals would be required. These again would need to be linked to 14 below.

14. Crewing.

Based upon the very limited information in this Division, it appears that it is possible that the operator might be considering the feasibility

...../3

of operating the ACIB as a permanently manned unit, as opposed to the original intention of an un-manned unit. This is a dramatic change in operational philosophy, and may of course be an erroneous assumption on my part, or it may be re-considered in the light of any observation of experience from other operators of similar units.

Whatever the final outcome is, it is perhaps opportune to point out that permanent manning of the unit would require further consideration of safety certification, the extent of which may be minimal, of at least the following :-

(a) Life-saving provisions;
(b) On-board fire safety;
(c) Ship/platform access;
(d) Electrical system;
(e) Communication;
(f) Accommodation;
(g) Emergency equipment.

The above accurately reflects the position of this Division at present, in that items discussed would need to be considered prior to any certification that is requested, and such certification can only be considered when the owners have clearly defined their operational intentions and submitted proposals for modifying the unit to implement the safety level consistent with those intentions.

Should you require further clarification or discussion on any of the above, please let me know.

With very many thanks,

Yours truly,

R.G.WADE

Superintendent.

c.c. M.A.Ball
J.E.Laframboise
N.E. Rudback.

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APPENDIX "C"

DETAILED LIST OF MODIFICATIONS

ACIB MODIFICATION/REPAIR ITEM

System: Undercraft Inspection

Equipment: Lighting for undercraft inspection

Purpose: Increase undercraft visibility for skirt, notch and structure inspections.

Description:

The undercraft lighting system worked well in the areas where it was installed and, because of this, a great deal of useful information was obtained from the undercraft camera. Unfortunately, not all areas under the ACIB were covered by adequate lighting. The notch area and portions of the port and starboard sides could not be seen clearly and, in some conditions, not at all.

If four (4) more underwater lights were installed, this would cover the entire skirt system, notch included.

ACIB MODIFICATION/REPAIR ITEM

System: Undercraft Inspection

Equipment: Video camera

Purpose: Increase the ability to detect problems with skirts and notch, do detailed inspections over water and gather valuable information about craft reactions to various situations.

Description:

The undercraft video camera platform does not allow for vertical adjustment, therefore, the starboard side and rear as well as the notch area cannot be inspected at water level. It does allow the camera to be rotated 360+ degrees, but only by hand, and controlled by hand signals from the ACIB bridge. It cannot be controlled during unmanned operation.

Remotely controlled camera mounts are available which will rotate 350 degrees and allow 90 to 180 degrees vertical movement.

The camera and mount could be installed inside a heated plexiglass dome attached by a four point linkage to the side of the duo tank inboard of skirt segments No. 1 and No. 2. The whole arrangement would not have to move vertically more than 40 cm. This would simplify the lift/lower equipment.

This new arrangement would greatly reduce the chances of ice strikes. A bonus, due to the dome shape, is that ice would tend to glance off if a strike did occur. Another advantage of the dome shape is, if for some reason the camera could not be raised prior to going ashore, the four bar linkage and cable arrangement would allow it to be pushed up without sustaining any damage. This set-up could be controlled from the ACIB bridge or from a remote panel on board the ship.

ACIB MODIFICATION/REPAIR ITEM

System: Spray Aprons

Equipment: Vents

Purpose: To increase safety on deck by minimizing spray.

Description:

The 1982/83 season started with the spray apron fastened up short to reduce the spray escaping from the gap. This worked well except that ice formed inside and outside at the gap, preventing the escape of air from between the spray apron and the skirt segments and resulting in porpoising.

Lowering the spray apron sufficiently to prevent the top from freezing up stopped the porpoising but increased the spray onto the deck.

A simple modification to reduce the spray level is recommended. This consists of a flap over the top of the spray apron to direct escaping air and spray downward.

Documents Affected:

G&M Dwg. 533-10-001.

ACIB MODIFICATION/REPAIR ITEM

System: Main Skirts

Equipment: Skirt Segment

Purpose: Replacement of bent support tubes.

Description:

With the implementation of the new attachment modification for the skirts, the attachment system reliability has increased dramatically. The present method of attachment allows skirt removal over land only. However, removal and replacement can be done very quickly, estimated turnaround time being ½ hour.

The aluminum support tubes allow for easy and quick replacement of the tubes without weatherproofing. Their light weight contributes to easier handling of the skirt segment. Steel, although both stronger and cheaper than aluminum, is heavier and requires anti-corrosion treatment inside and out, which is vulnerable to constant rubbing. It is recommended that steel tubing should only be used in emergency, if aluminum is not available.

The aluminum tubing is not a standard item with any manufacturer and requires a lead time of 4 to 6 weeks with a minimum order of 1000 ft. or 50 each 20 foot lengths (305 metres or 50 each 6.1 metre lengths). For the 1983/84 season, two replacements are required plus eight more for the manufacture of spare segments. An estimate of the yearly requirement would be approximately five. This would be a total of nine years worth of supplies.

It is suggested that an order be placed as soon as possible to ensure there is no hold-up for the 1983/84 season.

Documents Affected: HSL Dwg. 500-18-040.

ACIB MODIFICATION/REPAIR ITEM

System: Main Skirts

Equipment: Skirt Segments

Purpose: To carry out repairs using a hot bonding method.

Description:

55 skirt segment soles are damaged to some degree. This ranges from a few fingers loose, but not yet pulled free, to the complete sole piece missing.

Between 11 and 15 March 1983, 5 skirt segments were modified. This modification consisted of removing the lower metre of sole and re-attaching it on the inside of the skirt segment using cold bonding and rivets. The modified segments were located at the bow of the ACIB, the area which sustains the most damage.

The ACIB was operated for the rest of the season suffering no further damage in this area.

If the skirt segment soles were mounted on the inside of the segment using a hot bonding method, the sole should have greatly improved reliability. With hot bonding and the present attachment method, it is estimated that the segments could go through an entire season before needing replacement or repairs.

Documents Affected:

G&M Dwg. 533-10-033.

HSL Dwgs. 500-94-024, 500-98-026, 500-98-035, 500-98-036.

ACIB MODIFICATION/REPAIR ITEM

System: Notch

Equipment: Spray Apron

Purpose: Cut down on attachment to wear apron failure.

Description:

The spray apron is attached to the end of the wear apron by D rings and shackles. A stronger attachment would be to use short lengths of belt hinge. This would also provide a lower profile and a neater appearance.

Documents Affected:

G&M Dwg. 533-10-002.

ACIB MODIFICATION/REPAIR ITEM

System: Notch

Equipment: Notch wear apron

Purpose: To increase the life of the notch segments.

Description:

The installation of a one piece extended wear apron from the carousel to the notch spray apron would minimize damage to the notch segments normally caused by cutting or snagging on protrusions on the ship's hull, pinching between the hull and the notch segment support beams.

The attachment can be the same as the present notch segment system at the carousel, while using a low profile attachment along the top of Nos. 4 and 5 notch segments. The type of attachment should be short sections of conveyor belt hinge, such as Flexco fasteners. This would reduce the chance of snagging on the ship's hull, as well as increasing the strength of the attachment.

The preent three piece arrangement of the wear apron does not protect the segments, particularly in the area of the carousel, where damage was incurred during the 1982/83 season. There were several instances of the upper attachments being pulled loose, due primarily to the type of attachment which snags easily.

Documents Affected:

G&M Dwg. 533-10-002.

ACIB MODIFICATION/REPAIR ITEM

System: Notch

Equipment: Notch Segment

Purpose: To minimize further damage to the notch segments.

Description:

Remove the anti-snag flaps and close the notch segment soles thus preventing ice entering or snagging the soles, wh'le providing for drainage.

The 1982/83 trials demonstrated the need to have no loose rubber hanging where there was any possibility of snagging or tearing.

Documents Affected:

HSL Dwg. 500-94-011, replaced by G&M Dwg. 500-94-011.

HSL Dwg. 500-98-004.

ACIB MODIFICATION/REPAIR ITEM

System: Notch

Equipment: Top attachment bracket on carousel.

Purpose: Increase the strength of the bracket.

Description:

The top bracket on the main carousel structure is the weak link in the notch boom system, and repairs have been simple and quickly carried out. However failures occurred frequently, and the addition of a ½" x 2" piece of steel to the underside is recommended to increase the strength and reliability without transferring failure elsewhere.

The attached sketches demonstrate how the proposed modification is to be carried out.

Documents Affected:

Aside from the attached sketches, no drawings are available at the present for the carousel area.

ACIB MODIFICATION/REPAIR ITEM

System: Hydraulics and winches.

Equipment: Clutches.

Purpose: Reduce wear and tear and increase maintainability.

Description:

The hydraulic systems are needed only during launch, notch and unnotching and removing at the dock. This constitutes less than 20% of the total operational time of the ACIB. Once the craft is notched with a ship the hydraulics are no longer needed as the winches have brakes to lock them in position.

If the hydraulic packages had clutches installed, they could be shut down when not in use and quickly activated again when required. Another advantage to clutches is that an engine would not have to be shut down should a hydraulic pump fail. This set-up would greatly aid in the reduction of wear and tear on all hydraulic components.

Documents Affected:

ACIB MODIFICATION/REPAIR ITEM

System: Hydraulics and winches.

Equipment: Winch controls at the winch stations.

Purpose: Improve reliability, serviceability and life of the winch controls.

Description:

At the present, the winch controls at the winches have no protection from the elements. After an operational day it is not uncommon to have the controls completely covered in ice. At the beginning of the 1982/83 season, the port control had to be replaced while the starboard control had to be cleaned before the winches were considered serviceable.

In the absence of a complete ACIB cover, small tilt-away covers should be installed over the controls to protect them while not in use. This would greatly increase the reliability and life of the components.

ACIB MODIFICATION/REPAIR ITEM

System: Hydraulics and winches.

Equipment: Transit winches and cables.

Purpose: Reduce the present manoeuvring problems.

Description:

The area at the CCG Thunder Bay dock quickly becomes packed with ice rubble. Subsequently, manoeuvring at the dock becomes extremely difficult with the power available on the transit winches at present.

Also, during the landing operation, the transit cable is needed to act as a stabilizing cable and for lateral positioning on the landing pad. This is difficult with the power available.

If the cable size on the transit winches was increased to 1" with a corresponding increase in winch pressure, ease of manoeuvring would be greatly improved.

Documents Affected:

ACIB MODIFICATION/REPAIR ITEM

System: Hydraulics and winches.

Equipment: Fluid lines.

Purpose: Clean up the hydraulic packages and extend the life of the fluid lines.

Description:

At present, the hydraulic lines are mostly flexible, and necessitate provision for large radius bends. This has led to a cumbersome and unsightly mess of tubing within the compartments and on deck.

With properly formed steel tubing, the compartments would be much neater in appearance and more compact. Steel tubing would reduce the maintenance and increase the life of the lines, and thus of the system. Steel lines could also be used out to the winches, with a short length left as flexible for shock and vibration absorption.

An extension to the above is to move all the interconnecting lines, which are at present overhead, down onto the deck inside a tray. Couplings in appropriate places would aid in the installation and maintenance of the system.

Documents Affected:

ACIB MODIFICATION/REPAIR ITEM

System: Hydraulics and winches.

Equipment: Fairleads.

Purpose: Prevent further damage to notching and transit cables.

Description:

To prevent further damage to transit and notching cables is the installation of four Port Colborne fairleads is required, one for each winch. The present fairleads allow the cables to foul the deck edge. Because these cables are essential for launch, moving at the dock and notching, as well as for safety reasons, it is imperative that they be kept in a state of good repair. The cost of repair and replacement can be appreciably reduced by the installation of this type of fairlead.

Documents Affected:

HSL Dwg. 533-00-001, 533,-48-001.

Vulcan Dwg. 10962.

ACIB MODIFICATION/REPAIR ITEM

System: Hydraulics and winches.

Equipment: Winches.

Purpose: Increase safety and serviceability.

Description:

There is a need to move both sets of winches to the rear at least 1 metre. This would allow for a walk space around the winches, as well as reducing the danger of some protrusion at the dock breaking a line or valve and disabling the winch.

Documents Affected:

HSL Dwg. 533-48-001.

ACIB MODIFICATION/REPAIR ITEM

System: Hydraulics and winches.

Equipment: Reservoir tanks.

Purpose: To prevent loss of hydraulic fluid in one system due to a slight list (about 1 degree).

Description:

The two hydraulic tanks and the balance line between them should be combined into one reservoir tank located in the storage room under the ACIB bridge. This tank should have the same capacity as the two present tanks. If it was positioned about 1 metre off the deck, this would maintain a positive head to the charge pumps. The present tank heaters could be done away with as the storage room is heated during winter operations.

Documents Affected:

G&M Dwg. 533-10-004.

ACIB MODIFICATION/REPAIR ITEM

System: Hydraulics and winches.

Equipment: Controls, winches.

Purpose: To allow control of all four (4) winches at the same time.

Description:

At the present, the winches can be run only in pairs (i.e. both transit or both notching or one notching and one transit). It would be a great help in launching and notching to be able to run all four winches at the same time. For example, during launch, while the notching winches are being payed out, slack in the transits could be taken up without stopping, to prevent over-running. Similarly during notching to the ship, while the notching winches are pulling the ACIB in, slack on the transits could be taken up at the same time. This could be achieved quite simply by adding a second set of valve controls in parallel with the first with the system selection switch set to transfer control to starboard or port or both. This would allow the utilization of all four pumps at the same time while still retaining the ability to switch to a single system should there be a failure or engine shutdown.

Included is a complete description of how the new system would work.

Documents Affected:

G&M Dwg. 533-10-005 replaces Collingwood Shipyard Dwg. GEC-1074.

G&M Dwg. 533-20-001 supersedes Bell Aerospace Dwg. S-10355.

ACIB MODIFICATION/REPAIR ITEM

System: Hydraulic.

Equipment:

Purpose:

Description:

The hydraulic system on board the ACIB consists of two independent hydraulic systems, the pumps of which are driven from the starboard and centre engines. The two systems pick up fluid from one reservoir and supply it at the required pressure to four winches, transit and notching, on the starboard and port sides.

The hydraulic winches can be operated from three positions using the following scenarios:

- o The centre and starboard engines driving pumps No. 1 through No. 4 at the same time supplying all four winches.
- o The centre engine driving pumps No. 1 and No. 2 supplying only two winches at a time.
- o The starboard engine driving pumps No. 3 and No. 4 supplying only two winches at a time.

The positions are located, one at each pair of winches and one at the remote controller on the bridge of the ACIB.

NOTE: There are no winch controls at the remote console on board the ship.

The remote controller is the master control for the entire hydraulic system. It has control over the following functions:

- o Electrical power for control via two key locking ON/OFF switches.

ACIB MODIFICATION/REPAIR ITEM

. . . Cont'd

- Hydraulic system selection (CENTRE, STARBOARD, or BOTH) by one, three position switch.

- Control position selection (WINCHES, BRIDGE or OFF) by two, three position switches.

All control positions have an emergency electrical shutoff, as well as individual winch control via selection switch when active and winch valve controller for speed and direction.

There is a winch valve controller for each winch. They are infinitely variable in both pay-out and heave. The controller handle points in the direction of cable travel and has a "dead man" return in order to minimize confusion and increase safety. Each winch has a normally closed Denison control valve on the winch brake line, to prevent winch movement when the power is shut off. These were installed to prevent movement caused by a faulty MOOG pump controller. During manual operation this valve would have to be held open.

PRE-START UP CHECK

Prior to starting up the hydraulic system, the following checks must be carried out:

- Check the oil level in the reservoir and fill as required. Gauge glass should indicate about ¾ full.

- Check that the globe valves at the port and starboard winches are closed.

- Check that four (4) red EMERGENCY STOP buttons are pulled out (one at each local station and two at the remote controller).

- Check that the eight (8) winch valve controllers are in the centre (vertical LOCKED position).

ACIB MODIFICATION/REPAIR ITEM

. . . Cont'd

NOTE: The winch valve controllers are of "dead man" type (spring return to centre). If a controller is not on centre, then it is to be replaced immediately.

- o Test alarm circuit on centre engine panel.

SYSTEM START-UP

- o Start up the centre, starboard, or both engines.
- o Set system selector switch to system desired (CENTRE, STARBOARD or BOTH).
- o Switch on the remote controller with the two key operated switches at the bottom of the panel.
- o Switch the two control position switches at the top of the panel to the position desired and check that the green POWER ON lamps light for the position selected.
- o At each hydraulic system, check the following gauge readings:
  - Heave and pay-out gauges read 200-300 psi.
  - Port and starboard charge pressure gauges read 200-300 psi.
  - Transit pressure gauge reads 0 psi.
- o Check each system for leaks.
- o Check for alarms.

SYSTEM SHUT DOWN

- o Ensure all controllers are in neutral.
- o Turn the two control position switches to the OFF position.
- o Turn the two key lock switches to OFF and withdraw the keys.

ACIB MODIFICATION/REPAIR ITEM

. . . Cont'd

REMOTE CONTROLLER

To operate the winches from the remote controller, set the following switches to:

- o System selection: CENTRE, STARBOARD, or BOTH
- o Control position: here (this is the ACIB bridge)
- o Winch selection: NOTCH or TRANSIT

NOTE: The winch selection switch is inactive when the system selection is set to BOTH.

During launch, notching or going ashore, the normal selection for the system selection switches will be on BOTH. This activates all four winch valve controllers, one for each winch. The location of the valve controllers corresponds to the winch lateral positioning and the direction the handles are moved are the directions the cables from each winch will travel.

If the system selection is set to either CENTRE or STARBOARD, then the winch selection switch is activated and only one winch per side may be selected and used at a time.

WINCH CONTROL STATION

The operation of the winch valve controllers for the winches at the winch station is the same as the remote controller. The control selection switch (at the remote controller) is set to WINCH then the winch control station is active. If the system selector is on CEMTRE or STARBOARD, the winch selection switch is set to the desired winch. If the selector is on BOTH, the winch selection switch is inactive.

NOTE: The port winch control station will only operate the port winches and the starboard side will only operate the starboard winches.

ACIB MODIFICATION/REPAIR ITEM

. . . Cont'd

MANUAL OPERATION OF THE HYDRAULIC SYSTEM

(four men required for this operation)

- o This mode of operation is to be used only when the electrical system fails.

- o When the electrical system fails, all main switching valves V1 through V8 will remain in the last position selected with the exception of the BOTH selection. This will assume the same position as the CENTRE selection.

- o To operate the winches in the manual mode, certain conditions must be met:

  - Either the bow, starboard or both engines must be running.

  - The solenoids at the appropriate valves must be manually selected for the position and winch desired (see G&M Dwg. 533-10-005 for position and selection table).

  - The only valve solenoids which need to be held open or the lines removed and interconnected would be the brake valve solenoids V9-V12 (see G&M Dwg. 533-10-005).

- o Each valve is inscribed with its appropriate number and each solenoid is marked with the letter "A" or "B".

- o Each pump has a control valve (MOOG) mounted on the side. On each pump control valve there is an operating butterfly lever, which is located on the top of one and on the bottom of the opposite pump control valve.

ACIB MODIFICATION/REPAIR ITEM

. . . Cont'd

- Once it has been decided which winch is to be moved and the above conditions met, the operator will then move the butterfly control lever on the control valve at the appropriate pump. The direction of the winch movement will have to be determined by communication between the control valve operator and the winch handlers.

ACIB MODIFICATION/REPAIR ITEM

System: General

Equipment: Ship boarding ladder.

Purpose: To set up a proper attachment system for the boading ladder to the ship's bow.

Description:

The present attachment of the boarding ladder to the ship's bow is difficult to set up as well as not being very safe. Problems have arisen lining up and installing the attachment pins. The ladder, at times, strikes the wiring tray and port engine enclosure if the ship is not all the way into the notch.

The attachment needs to be easily set in place, as well as safe and easy to use. It should also have provision for emergency boarding should problems arise, and it should have the ability to pivot to allow for alignment and movement of the ship. If the ladder was located on the centreline of the deck, lined up with the notch, then the position of the ship in the notch would not matter; and with the advent of the fluid ballast system, this could be accomplished very easily, as there would be no obstructions on deck.

Documents Affected:

533-00-014.

ACIB MODIFICATION/REPAIR ITEM

System: General

Equipment: Spare skirts and material.

Purpose: To supply spares as necessary for craft maintenance.

Description:

At the present, there are no spare skirts and only a small amount of spare material left after the 1982/83 season. The 1983/84 season will require at least a minimum quantity of spare equipment.

The required list of spare skirts is as follows:

o	Straight skirt segments	each 2
o	Corner skirt segments	each 2
o	Notch segments	each 1
o	Skirt material for patches	each 1 roll

Documents Affected:

ACIB MODIFICATION/REPAIR ITEM

System: General

Equipment: Drawings

Purpose: Needed for certification and repair and maintenance.

Description:

At the present, the ACIB drawings are those produced by Hoverlift Systems. Since these were drawn, there have been extensive changes to the craft. The notch system has been changed extensively only superficially resembling the main assembly drawing. The skirt attachments, ACIB control platform, engine enclosures, deck rail, fairleads, and other items have all been altered in some way, and "as built" drawings are required. 90% of the present drawings are affected in some manner, from a single line or dimension change to the requirement for a complete new drawing.

The lack of "as built" drawings greatly inhibits designing new modifications or repair and maintenance procedures without going to the craft and designing on site (an expensive process). Repairs without proper drawings means, for example, in the case of the electrics, tracing the system for each problem as it arises. This is true for most systems, AC or DC electrical, hydraulic, notch and control systems to name a few.

A proper set of "as built" drawings would reduce the time and costs involved in the repair and modification of the ACIB.

Documents Affected:

ACIB MODIFICATION/REPAIR ITEM

System: General

Equipment: ACIB cover.

Purpose: Provide environmental protection, and enhance safety and comfort.

Description:

A definite asset in the operation of the ACIB would be a lightweight removable cover over the whole of the craft. The space under the cover could be heated quite easily from the engine waste heat thus providing better and safer working conditions on board. This cover would have side panels which could be rolled up out of the way for launch, moving at the dock and notch/unnotch with the ship. Once in operation, the panels would be rolled down to provide a weatherproof, warm working area, as well as excellent protection for all machinery and controls.

The cover would enclose the fans, and consequently adequate provision must be made for the fan intakes. This could be done by the installation of gooseneck intakes.

Documents Affected:

533-00-002.

ACIB MODIFICATION/REPAIR ITEM

System: Fire protection system

Equipment: Main engine system.

Purpose: Increase safety on the ACIB and the fire protection of the main engines.

Description:

The present fire protection system does not appear to be adequate for the engine enclosure design presently in use on the ACIB.

It is proposed to re-design the engine cooling system so that the intake and outlet louvres close automatically when the engine is stopped in emergency. This will reduce loss of gas to a minimum when the fire extinguisher is activated.

Outlet louvres will also be increased in area to permit greater cooling flow through the enclosure and eliminating the necessity to open the doors at ambient temperatures above about -5°C.

Documents Affected:

ACIB MODIFICATION/REPAIR ITEM

System: Fire protection system

Equipment: Main engine extinguishing bottles

Purpose: Increase the protection of the firing head and the general appearance of the ACIB.

Description:

The present rubber flap over the hand firing controls of the fire extinguisher bottles served the purpose of preventing icing of the controls during the 1982/83 season. The covers are just barely adequate and do not look very good.

A new and properly designed cover should be installed over the controls to improve the protection as well as the looks.

Documents Affected:

ACIB MODIFICATION/REPAIR ITEM

System: Engines

Equipment: Enclosures

Purpose: Increase ease of maintenance

Description:

The original design for the ACIB called up walk-in enclosures for the three diesel engines. In the event, smaller enclosure was installed.

The present arrangements protects the engines but leads to the following problems:

- In outside temperatures above about minus 5°, the engine compartment doors must be kept open to prevent engine overheat. This is not a safe condition in case of engine compartment fire.
- Some areas of the engine are difficult to work on because of the closeness of the enclosure.
- The thermostatically controlled louvres on the radiators are not designed to close should a fire start.
- The open louvres at the rear of the enclosures are not adequate for engine cooling at ambient temperature above about -5°C and, under these conditions, the engine compartment doors must be kept open.

If walk-in enclosures were designed and installed, it would greatly improve safety, appearance and ease of engine and hydraulic system maintenance.

Documents Affected:

ACIB MODIFICATION/REPAIR ITEM

System: Engines

Equipment: Air pump

Purpose: Increase ACIB maintainability.

Description:

The port engine has an engine driven air pump attached which was used for the old notch support structure. This pump could be fitted with a regulator, air receiver tank and associated piping and outlets, for cleaning equipment and air powered tools for maintenance.

Documents Affected:

ACIB MODIFICATION/REPAIR ITEM

System: DC Electrics

Equipment: Instrumentation

Purpose: To clean up the instrument panels on the ACIB, sort out the wiring, and make necessary repairs.

Description:

There have been problems with some instruments on the port engine instrument panel. Curing one seems to lead to another. The difficulties are compounded by differences between the wiring and electrical drawings.

As an example, the port engine shutdown alarm goes on when the engine comes up to idle speed and goes off when the engine is shut down. As another, the port inlet guide vanes can be operated on manual, but not on automatic.

Other problems have required that the circuits be traced first, because they did not agree with the drawings or the wiring had been improperly marked.

When the overhead wiring is relocated on deck and the wiring shortened, the DC electrical system should be gone over to bring the wiring drawings up to date and correct all problems with the electrical system.

Documents Affected:

ACIB MODIFICATION/REPAIR ITEM

System: DC Electrical System

Equipment: Overhead Wiring

Purpose: Removal of the overhead trays for safety and neatness.

Description:

a) The main modification would be to relocate all electrical and instrument wiring to troughs on the deck, and shorten the wiring, eliminating a great deal of excess. Elimination of the overhead trough would increase safety when boarding the ship, and improve the general appearance of the ACIB.

b) A supplement to (a) would be to install Cannon connectors at each end of the cable bundles (60 connectors in all) at the time of the relocation and shorting. This would facilitate trouble shooting, repair and modifications to the system.

Documents Affected:

ACIB MODIFICATION/REPAIR ITEM

System: Main Deck and Buoyancy Tanks

Equipment: Buoyancy Tanks

Purpose: Increase safety and permit cargo handling on deck.

Description:

A corollary to the fluid ballast system would be the removal of all unused deck brackets and shear blocks leaving a clean deck which might be used for cargo during the open water season.

Documents Affected:

HSL Dwgs. 533-00-001, 500-18-001, 500-18-025, 533-00-008, 533-00-009, 533-00-010.

ACIB MODIFICATION/REPAIR ITEM

System: Main Deck and Buoyancy Tanks

Equipment: Buoyancy tanks used for ballast.

Purpose: Increase safety, visibility on deck, and accessibility.

Description:

The present ballast system consists of concrete blocks, each weighing about 8900 lbs (4037 kg). There are 22 blocks for a total of 195,900 lbs (88,860 kg). The loading and unloading is expensive, time consuming and restricted to the dock only, as a 60-ton crane is required for a ballast change. Some ballast is required at all times, if for no other reason than to trim the craft. The present ballast, located on deck, raises the ACIB's vertical centre of gravity, thereby decreasing the stability on hover.

If the ACIB had a fluid ballast system located in the buoyancy tanks, the vertical centre of gravity would be considerably lower, with a corresponding increase in stability on or off hover. With the associated pumping system, the craft could be easily trimmed, and, in case of an emergency, the fluid ballast could be pumped overboard thus increasing buoyancy, which is impossible at present.

If the fluid ballast was fuel oil, there would be no requirement for heaters to prevent freezing, and it could be used as fuel for the diesels, thus eliminating the dependence on shipboard fuel (which may prove incompatible with the ACIB's engines). Under normal conditions, there would be no need to dump ballast overboard, just move it from tank to tank as required to trim the craft for and aft as well as laterally. This would also help in maintaining a reasonably constant all-up weight during operations. If a change of ballast was required, the extra fuel could be pumped aboard ship or to a fuel truck on shore at a rate of about 1000 GPM.

The ACIB has three buoyancy tanks, two tri tanks and one duo tank. The two tri tanks could be divided into three tanks each and the duo tank into two tanks. The construction of the duo and tri tanks lends itself to this kind of arrangement with a minimum of modification. One tank would not affect trim, while the others could be used to change trim. With the eight tanks,

ACIB MODIFICATION/REPAIR ITEM

. . . Cont'd

there would be sufficient space even at full allowable ballast to be able to trim the ACIB quite easily. Each tank would hold about 4500 Imp.gallons (20,460 litres).

A supplement to the above would be to remove the present trim ballast tanks and build tanks under the deck in the same area replacing the buoyancy blocks which are located there at the present. This would allow an increase in size of the trim ballast which is badly needed as well as clearing the deck for easier access during launch and notching operations, and improving the view of the ACIB's deck from the ship's bridge.

With these seven tanks, the ACIB has a capacity of 115 metric tons of fuel not counting the trim ballast tanks. One tank could be held in reserve should any of the others develop a leak for any reason.

Documents Affected:

HSL Dwgs. 500-18-001, 500-18-002, 500-18-003, 500-18-004, 500-18-005, 500-18-006, 500-18-007, 500-18-025, 500-18-026, 500-18-027, 500-18-028, 500-18-029.

ACIB MODIFICATION/REPAIR ITEM

System: Main Deck and Buoyancy Tanks

Equipment: Deck

Purpose: Increase safety on deck.

Description:

The buoyancy tanks have been painted with an epoxy paint which is very slippery and hazardous when wet or snow covered.

The deck should be painted with a non-skid paint, which would greatly increase safety.

Documents Affected:

ACIB MODIFICATION/REPAIR ITEM

System: Control Platform

Equipment: ACIB Bridge Controls

Purpose: Increase safety and ease of operation.

Description:

The engine controls and instrumentation are grouped in three panels, one for each engine. This spaces the throttles and tachometers so far apart and so low down that two persons are required for operation, and during operation cannot see out. The present throttles are, in fact, governor controls, and were not designed to be used in the way they are being used at present.

As an example, there was a port engine clutch failure. All three throttles were being opened to 1600 RPM. The operator happened to stand up for a quick look around at the exact instant the clutch on the port engine failed. The vibration was enough to open the engine compartment doors, which are normally held closed by ¼" steel pins, and was of sufficient amplitude to be visible both on the fan and engine.

If the operator had not released the controls and raised his head at that particular time, he could not have seen what was happening soon enough to shut down the engine and prevent extensive damage to both engine and the fan.

It would be much safer and easier to operate if the tachometers and throttles were located on a pedestal as a unit. With such grouping, the operator can monitor all three engine speeds, and have all round visibility at the same eye level.

Documents Affected:

ACIB MODIFICATION/REPAIR ITEM

System: Control Platform

Equipment: Control Platform

Purpose: Increase room, efficiency and storage.

Description:

It would be uneconomical to attempt to repair and upgrade the present control room structure. It needs to be finished and painted on the outside as well as inside. Also the area underneath the control room requires insulation and heating, and should be laid out to provide adequate space for a workbench and tols, as well as storage lockers.

For any extended operation, the ACIB needs to carry engine, fan and hydraulic oils and these need to be kept warm. There is also a need to have tools aboard in a sheltered space, along with such things as assorted shackles, short chains, snatch blocks, and ropes. The storage contains all 110V/220V AC switching and main junction boxes. It is proposed to install the hydraulic reservoir tank in the storage, as it is a central location between hydraulic packages, and should be convenient and warm.

A new control room should be designed and built around all the present equipment and instrumentation, but be able to accommodate all recommended new equipment and instrumentation. If layout is efficient, it need not be larger. The main group of changes to be combined with a new control room structure would be:

- The trough removal and subsequent relocation and shortening of the main control wiring.
- The re-design of the 110V/220V AC electrical system.
- Hydraulic tank installation and piping changes.
- Diesel throttle controls.
- Hydraulic control installation.

Documents Affected:

ACIB MODIFICATION/REPAIR ITEM

System: ACIB Controls

Equipment: Remote Panel

Purpose: To increase safety, ease of operation and efficiency.

Description:

The present remote control panel is poorly laid out from the viewpoints of operation and monitoring. Instruments and controls are not grouped in logical patterns such as those used on aircraft. Rearrangement, which is a straightforward modification, will enhance considerably ease of operation and detection of trouble.

Documents Affected:

G&M Dwg. 533-10-006.

ACIB MODIFICATION/REPAIR ITEM

System: AC Electrical System

Equipment: Heaters

Purpose: Increase craft reliability, crew comfort and ease of craft maintainability.

Description:

There are no permanent heaters in the storage area under the ACIB bridge. There is a requirement to keep engine, fan and hydraulic lubricating oil on board along with operating equipment such as snatch blocks, ropes, assorted shackles, chains and tools. The oils must be kept warm in order to top up the respective systems while warm tools and equipment makes maintenance much easier. If the space was heated, it could also be used as a small parts repair shop where warmth is needed for bare hands work.

Documents Affected:

ACIB MODIFICATION/REPAIR ITEM

System: AC Electrical System

Equipment: Lighting

Purpose: Increase safety while operating, inspecting or servicing equipment at night.

Description:

The present deck lighting allows a person to move about the deck at night with safety, but is inadequate to operate, inspect or service any equipment after dark.

The addition of adequate lighting at each winch location and in the notch area would allow the crew to notch and unnotch more easily and with greater safety during hours of darkness.

Documents Affected:

ACIB MODIFICATION/REPAIR ITEM

System: AC Electrical System

Equipment: Lighting and Outlets

Purpose: To allow the use of standard, readily available lights and tools.

Description:

The lighting on the ACIB bridge is 24 V DC only, and should be duplicated with 110V AC lighting to provide duplication of an essential system.

The lighting and electrical outlets in each engine compartment are 24 V DC, requiring the purchase of special tools and equipment. If the lights and outlets were converted to 110 V AC, the purchase of tools equipment would be greatly simplified. The ACIB has 75 kW of electrical power, of which only about 25% is in use if all electrical circuits are on.

Documents Affected:

ACIB MODIFICATION/REPAIR ITEM

System: AC Electrical System

Equipment: 120V/208V AC

Purpose: To increase safety and make efficient use of available power.

Description:

The 120V/208V AC system on board the ACIB has developed in a haphazard manner and should now be redesigned on a rational basis. Loads per breaker should be equalized as far as possible, and systems spread between breakers to provide as much duplication as possible, especially with lighting and power outlets.

Documents Affected: